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ANSTO Samples - 24 Hour Report

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Disclaimer

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Australian Nuclear Science & Technology Organization (ANSTO) Interdicted Samples

24-Hour Report

Laboratory: Lawrence Livermore National Laboratory (United States of America)

Current Status: Categorization is complete. Samples 11-3-1 (NSR-F-270409-01) and 11-3-2 (NSR-F-270409-02) are depleted uranium powders of moderate purity (~65-80 % U). The uranium feed stocks for 11-3-1 and 11-3-2 have both experienced a neutron flux (as demonstrated by the presence of ^{232}U). Sample 11-3-3 is indistinguishable from a natural uranium ore concentrate of moderate purity (~70-80% U). Two anomalous objects (11-3-1-4 and 11-3-2-5) were found in the material during aliquoting. These objects might be valuable for route attribution.

Potential Issues: None

Delivery Details

Shipment arrived at LLNL Materials Management:	November 29, 2010
Package delivered to LLNL Nuclear Forensics Team:	9:30 AM/December 1, 2010
Package Opened/Exercise Started/Chain of Custody Initiated:	9:20 AM/January 26, 2011

Initial Inspection and Photo Documentation

The outside package was a standard cardboard shipping box (see Figure 1). Inside this box, we found a sealed metal can protected by Styrofoam packaging (see Figure 2). All swipes taken outside the can and inside the box were “clean” (no radioactive contamination). The count rate at the surface of the can, using a standard beta-gamma meter with a pancake probe, was 1800 counts per minute. Upon opening the metal can, we found three screw-top poly vials inside plastic bags, all of them secured by Styrofoam packaging (see Figure 5). All swipes taken outside the plastic bags and inside the can were “clean” (no radioactive contamination). Each of the plastic vials contained powdered material and were labeled with both an “NSR” sample identifier and an apparent mass of material (see Figure 6).

Sample Identification

Chain-of-custody was initiated on these samples as follows:

ANSTO Identifier	Mass	LLNL Identifier
NSR-F-270409-01	5.00 g	FSC-11-3-1
NSR-F-270409-02	5.00 g	FSC-11-3-2
NSR-F-130503	10.02 g	FSC-11-3-3

LLNL Measured Sample Mass
(mass of vial + sample – mass of empty vial after aliquoting)

11-3-1	4.9596 ± 0.0004 grams
11-3-2	5.0367 ± 0.0004 grams
11-3-3	9.9737 ± 0.0004 grams

Note that the sum of the individual aliquot masses were in excellent agreement with the above masses for 11-3-1 and 11-3-3. The sum of the aliquoted masses for sample 11-3-2 were lighter than the above mass by 87 mg, but this sample had suffered a small loss of material during aliquoting. In addition, we identified an anomalous object (see below) in 11-3-2, for which we have yet to measure the mass. The mass of the anomalous object found in 11-3-1 has not been measured either, but is anticipated to weigh very little.

Whole Sample Gamma Spectrometry Results

Note: Whole Sample Gamma Spectrometry performed for initial categorization only. We will obtain higher accuracy and precision from whole solution gamma spectrometry and inductively coupled mass spectrometry.

Table 1 Whole Gamma Spectroscopy 24-hour Results

	$^{235}U/^{238}U$	$^{234}U/^{238}U$	$^{226}Ra/^{238}U$	$^{239}Pu/^{238}U$	gU/gSample	^{232}U	$^{40}K/^{238}U$
11-3-1	4.23E-3 ± 1.5 %	2.71E-5 ± 10.8%	9.4E-12 ± 49%	< 5.5E-6	0.693 ± 5%	Present	7.3e-5 ± 20%
11-3-2	4.00E-3 +/- 1.4%	2.57E-5 ± 12.6%	1.42E-11 ± 31%	< 5.3E-6	0.750 ± 5%	Present	< 1.2e-5
11-3-3	7.25E-3 +/- 1.3%	5.88E-5 ± 6.1%	1.75E-12 ± 22%	< 3.1E-6	0.758 ± 5%	Below DL	< 1.6e-5

Therefore, samples 11-3-1 and 11-3-2 are depleted uranium, and their feedstock has experienced a neutron flux (as demonstrated by the presence of ^{232}U). Sample 11-3-3 is indistinguishable from natural uranium. With a few assumptions about chemistry, it should be possible to calculate an age from the ^{226}Ra concentration. Other fission products, including ^{54}Mn, ^{60}Co, ^{106}Ru, ^{125}Sb, ^{137}Cs, ^{144}Ce, ^{152}Eu and ^{182}Ta, are below our detection limits, which have yet to be quantified due to a shortage of time.

Figure 1. Package as received

Figure 2. Metal can inside Styrofoam packaging

Figure 3. Metal can inside box.

Figure 4. Metal can

Figure 5. Interior of metal can with samples in plastic bags

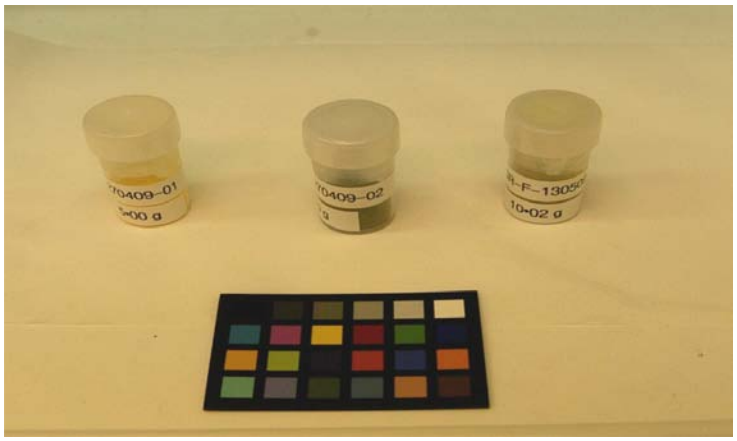
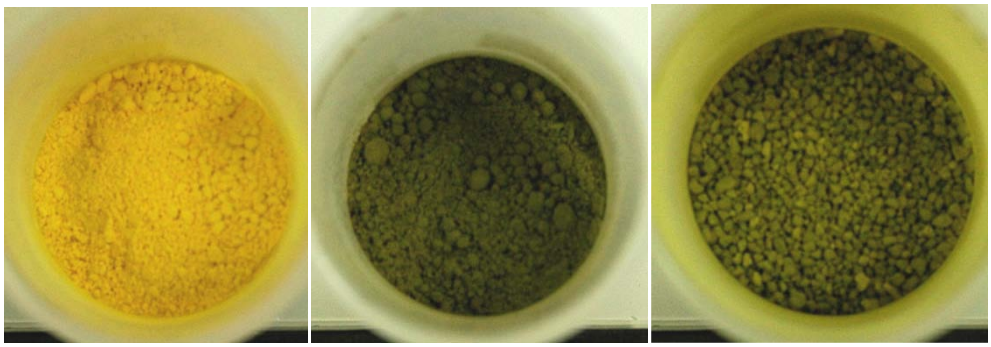


Figure 6. Three (3) sample vials.



FSC-11-3-1	FSC-11-3-2	FSC-11-3-3
NSR-F-270409-01	NSR-F-270409-02	NSR-F-130503

Figure 7. Sample material inside containers

Visible/Infrared Spectroscopy Results

The Vis/NIR diffuse reflectance spectra of the samples were acquired in the original containers without any sample preparation. Further analyses of the Vis/NIR spectra are necessary and the preliminary conclusions presented here are opinions based on experience with similar type samples.

The spectra from samples 11-3-2 and 11-3-3 appear to be similar and have likely undergone similar processing, although there are spectral differences that indicate that they may not be from the same source. The yellow sample 11-3-1 is not only rather different in visual appearance but also has a very different NIR spectrum, indicating potentially both a difference in processing and source.

In conclusion, sample 11-3-1 is both chemically and visually different from the other two samples (11-3-2 and 11-3-3), suggesting a different processing history.

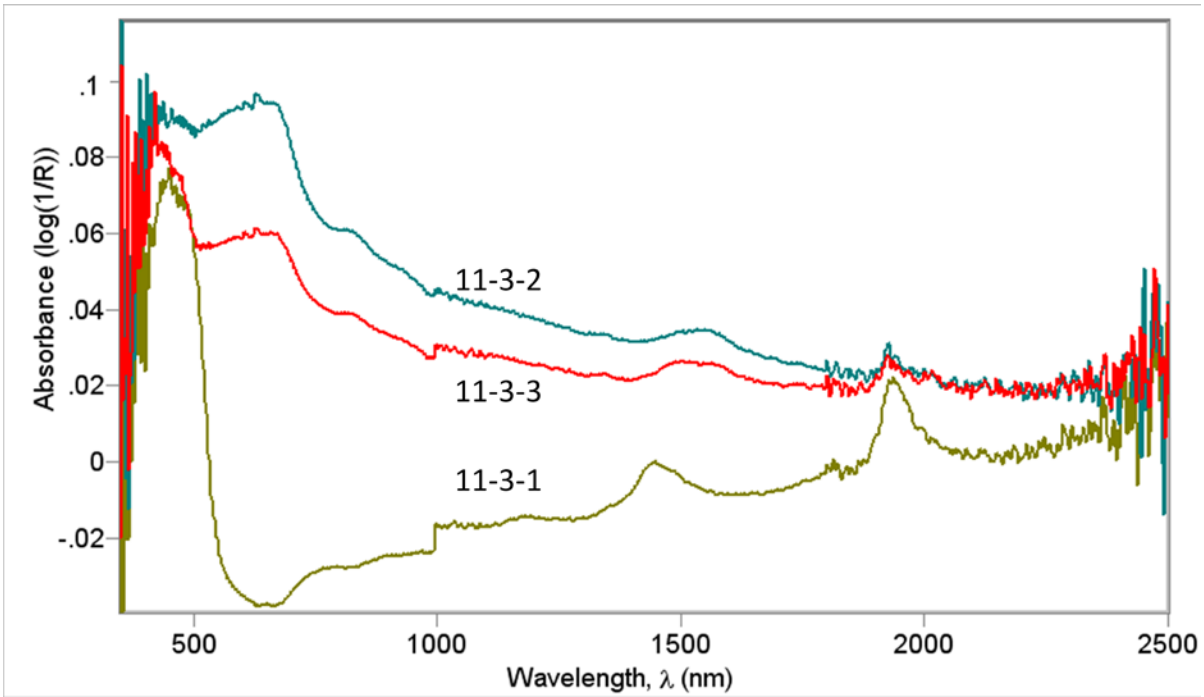


Figure 8. Vis/NIR spectra of ANSTO samples.

Anomalous Objects

FSC-11-3-1-4

While aliquoting sample 11-3-1, we discovered an anomalous object, long and narrow in shape and fibrous in appearance (see Figure 9). We separated the object, placed it in a small glass vial, and initiated chain-of-custody for the object as FSC-11-3-1-4. A quick, initial investigation using an optical microscope showed that the object had some similarities to an insect (see Figure 10). However, further investigation under more controlled circumstances will be necessary to confirm this.

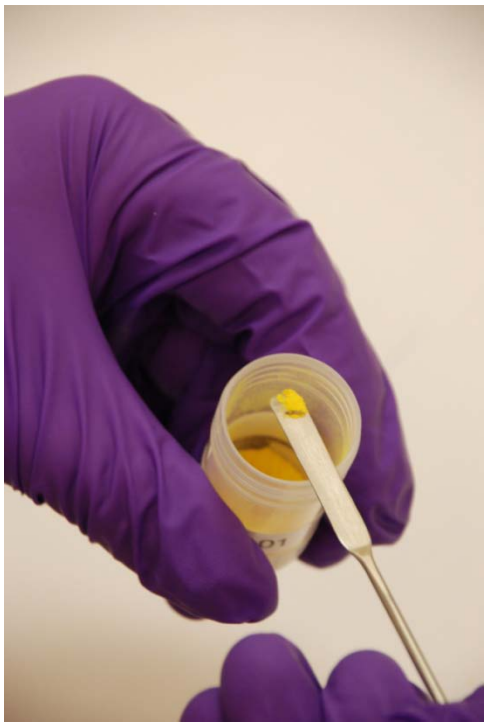


Figure 9. Anomalous fragment

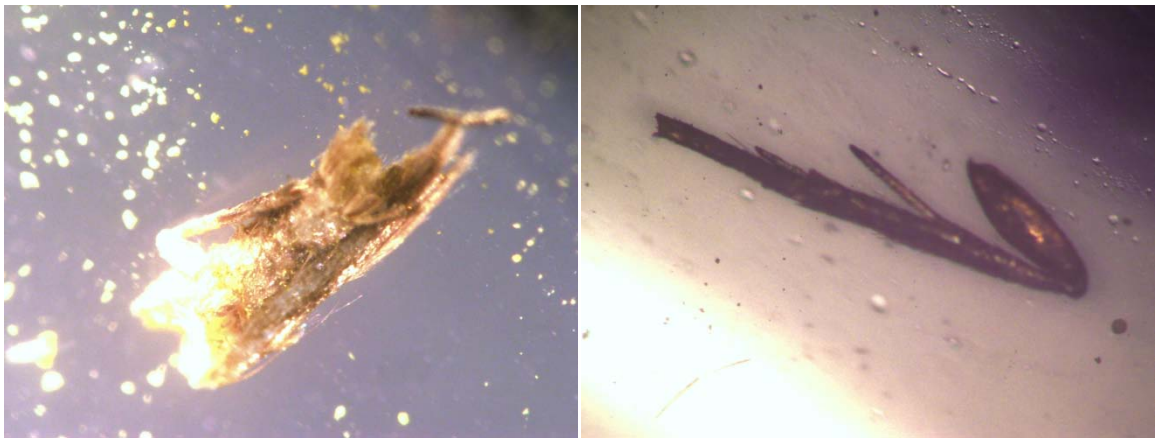


Figure 10. Optical photomicrographs of 11-3-1-4 (low magnification) and a separate piece which appears to have fallen off the main object (higher magnification)

FSC-11-3-2-5

While aliquoting sample 11-3-2, we discovered what appears to be a metal staple (see Figure 11). We isolated the object, placed it in a small glass vial, and initiated chain-of-custody for the object as FSC-11-3-2-5.

Figure 11. FSC-11-3-2-5

Technical Interpretation

Note: Technical interpretations are technical judgments based upon current results and will evolve as more results are obtained.

Categorization is complete. Samples 11-3-1 (NSR-F-270409-01) and 11-3-2 (NSR-F-270409-02) are depleted uranium powders of moderate purity (~65-80 % U). The uranium feed stocks for 11-3-1 and 11-3-2 have both experienced a neutron flux (as demonstrated by the presence of ^{232}U). Sample 11-3-3 is indistinguishable from a natural uranium ore concentrate (~70-80% U) of moderate purity. Other fission products, including ^{54}Mn, ^{60}Co, ^{106}Ru, ^{125}Sb, ^{137}Cs, ^{144}Ce, ^{152}Eu and ^{182}Ta, were below our detection limits, which have yet to be quantified due to a shortage of time.

Vis/IR spectroscopy suggests that sample 11-3-1 is both chemically and visually different from the other two samples (11-3-2 and 11-3-3), suggesting a different processing history.

Two anomalous objects (11-3-1-4 and 11-3-2-5) were found in the material during aliquoting. These objects might be valuable for route attribution.